Home on the Range in the Urban Landscape:
A Case Study at Cesar E. Chavez High School

Gerald McDonald
Chavez High School

INTRODUCTION

There is the old saying that says, "If you build it, they will come." Perhaps it should be more accurately stated that "If you build it right, they will stay." I teach agricultural science and technology in the Environmental Magnet Academy at Cesar Chavez High School in Southeast Houston. Our school is located near the Sims and Berry Bayous and is in close proximity to the Houston Ship Channel. The courses I teach do not focus on the traditional production agriculture one might think of when one hears the term "agriculture." Rather, we address the environmental, energy, and natural resources in the curriculum we offer our students.

My students have been working closely with the U.S. Forest Service to make our outdoor learning center become a reality. The center officially named the Cesar Chavez Outdoor Learning Center was formally dedicated in April 2004. In June of this year, we were notified by the U.S. Fish and Game Service that our center had been selected as the recipient of the *2004 National Wetland Conservation Award for Region 2*. A commemorative stamp will be presented to the school to recognize this achievement. One of the unique components of our outdoor learning center is the inclusion of a "prairie" study area. One of the projects students took great pride in this past year was the planting of native grasses and wildflowers in this upland prairie section of the learning center. Students will also develop a resource guide which will include information on plant identification that will be provided to teachers who sign up to utilize the outdoor learning center to classroom instruction. The specific location of the center consists of 17 acres, and is primarily in a "wetlands" area. A four foot elevated boardwalk was constructed with the assistance of The Telephone Pioneers of America that passes over a pond adjacent to the bayou. At the request of the Harris County Flood District there is no direct access to the bayou, although with some effort it is possible for the motivated to get to the bayou. The pictures below represent two of the major "study areas" of the center. Leaving the prairie and following the packed granite trail down a short hill, you enter the "woodlands" area of the center (Figure 1). There are several viewing opportunities here. Adjacent to the woodlands there is a "wetlands" area which is accessible by a boardwalk. (Figure 2)

Figure 1- Beginning of Woodlands Area

Figure 2- Boardwalk crossing over Wetlands

BACKGROUND

I have taught agricultural science and technology courses for many years, but never before have had I had the opportunity to focus on the environment and environmental issues as I do in my present assignment at Cesar Chavez High School. My involvement in agriculture actually extends all the way back to my childhood. Growing up in a small farming community in west Texas, I learned at a very early age that taking care of the land (environment) meant higher yields and more profit. At the time I did not realize the other, more intangible results of our efforts would far outlast any amount of money earned from the selling of those precious crops. Students enrolled in the Environmental Magnet at Chavez High School will benefit from my background, partially by following a specific coherent sequence of coursework that includes the agricultural science and technology electives I teach.

As we did in my most recent unit, *Beyond the Lobo Den, Walking on the Wild Side of Sims Bayou,* students will continue to focus on Sims and Berry Bayou through "hands on learning" field studies. The activities developed for this new unit will primarily be used in the Range Management & Ecology and Exploring Aquaculture courses I currently teach at Chavez.

At the beginning of the school year students will complete their annual inventory of plant and wildlife resources along Berry Bayou. As our "Upland Prairie" continues to mature, students will continue to collect and mount plant specimens, for display and further studies in the classroom. Students in my Range Management and Ecology course will continue to participate in the Chavez Environmental Magnet's Prairie Restoration Project. The area used for this restoration project is also used as a staging area that will lead students and campus visitors into the outdoor "wetlands" learning center. We are planning to install an information kiosk that will greet visitors as they enter through the pass gate that opens to the trail that will lead them through the various components of the outdoor learning center. Students have already constructed benches for the convenience of those who visit and tour our outdoor learning center. Visiting teachers will have the option of using their own lessons or if they chose they can request our assistance in providing lessons. There will also be opportunities for individuals to schedule visits to

our outdoor learning center. In these instances our students may be called on to act as tour guides.

Students, particularly those in Exploring Aquaculture, will conduct ongoing evaluation type activities dealing with water, land and air. We want to make certain the water and air quality continues to be appropriate for the purpose of attracting and sustaining the wildlife that visit the area. Applying the knowledge the students learn in their Exploring Aquaculture class, environmental study teams will use modern testing equipment to monitor water quality on a routine basis. Teams will first be given the task of creating a name for their team. Assignments will be rotated bi-weekly to give teams have the opportunity to collect information in all areas to be studied. Students will specifically conduct tests for the following: temperature, turbidity, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), apparent color, odor, alkalinity, hardness, nutrients, nitrates, Total Dissolved Solids (TDS) and Conductivity, and salinity. We plan to eventually install digital wildlife cameras at strategic locations along the winding trails in order to capture images of birds and mammals that stop by when no one is present. These captured images will ultimately be used for identification purposes as well as incorporated into power point presentations that will be shared with others.

Lessons related to advanced concepts in natural resource management will also be developed to further extend this unit. Students enrolled in Independent Study will use the resources available at the outdoor learning center to develop a project that will meet the criteria for the Distinguished Achievement Program. An example of an advanced project might be illustrating how Geographic Information Systems is used to map migration of waterfowl or even butterflies.

All agricultural science students at our school will be involved with the outdoor learning center in some capacity or other. Students will be involved in various projects to enhance and maintain the area. Range Management students will complete lessons on identification of native grasses and wildflowers, conduct species inventories, and determine the value of grasses. Students will also identify and label the trees, shrubs, and vines that are adjacent to the trails and indicate these on a map of the outdoor learning center. My aquaculture students will be given the primary responsibility of monitoring water quality in the wetlands region of the center and nearby Berry Bayou.

This unit is meant to be used as an ongoing project that will begin at the end of the second week of school and culminate in mid-May. The introductory lesson will occur by the end of the second week of school. This lesson will be the “exploratory” visit to the area that will serve as our outdoor learning lab for the remainder of the school year. On this first visit, students should assume the role explorer to an “unknown” land. They will be asked to take field notes to record what they see, hear, and smell. I am fortunate that my school is close enough to Berry Bayou that we can walk out the backdoor of my classroom and be standing at “water’s edge” in a matter of minutes. Because we operate on a modified block schedule with classes running 100 minutes, after allowing ten

minutes to move to the site and back to the classroom, we will have a full 90 minutes to take advantage of the outdoor learning experience. Students will use Fridays to transfer their field notes to their journals.

GETTING STARTED

Prior to the initial visit to the "outdoor learning" lab, it should be understood that to actually encounter wildlife will not be easy. Most species are nocturnal (active at night), and visits will be conducted during class time. Students will be looking for evidence of wildlife activity through the presence of tracks, scat (droppings) and remaining fur or feathers. Traces of evidence from the following animals to be found include mammals, birds, insects, reptiles, and if near water, fishes and amphibians. It should also be noted that in most cases this evidence will be observed and cataloged while in the field, and left behind. Furthermore, in preparation to move outside students, should first learn as much about the species of wildlife that might be found in the area. Students will look at mammals, birds, plants (flora), and aquatic life.

FLORA

Flora refers to plants and includes grasses, wildflowers, forbs, vines, shrubs and trees. Trees no doubt add tremendous appeal to both human and wildlife, and if you are fortunate as we were, there will be an adequate number of trees in close proximity to your selected site. This will ultimately save you a great deal of time and money. Before purchasing trees, be sure to check for sources of free offerings. In many instances not only will trees be donated, but assistance in planting will be provided as well. If you decide to do the planting yourself (an excellent learning experience for students) be sure to seek the advice of a local nursery, if you are not sure what to do. Planting depth for trees vary species to species and in some cases from region of state to region of state. Trees are classified as deciduous (looses leaves in colder weather) and evergreen (retains leaves year round). You will want a good blend of both in order to attract and hold wildlife yearlong.

Specific Trees and Other Woody Plants That Attract Wildlife

Below is a description of several different trees and other woody plants that are growing in our outdoor learning center as well as on the surrounding campus. I have also identified different species of birds and other wildlife that depend on these plants for food and shelter. In each instance the described cultivars are native to the Houston area. Students will learn how to identify the different specimens based on leaf characteristics, growing season, form or shape, and flowering characteristics.

Use caution when selecting plants for your outdoor learning center, especially if the center is going to be used by the very young student. While the plants described below may very well offer a "buffet of choice" for wildlife, some are toxic to humans. This

information is provided for your benefit. Remember that the safety of our students must remain as one of our top priorities when we use these outdoor learning opportunities. The table below should provide insight to some of the most popular among birds.

Although there are numerous different trees that attract wildlife (especially birds) only a few tree varieties will be discussed here. There are many wonderful books that merit reading if you would like to learn more about those that are predominant in your region. I have tried to identify not only the varieties that were actually already growing on our campus, but those that are more or less common to all regions. Each time you venture into your garden or outdoor learning center pay close attention to which trees birds are feeding. You will soon discover that this changes along with the seasons of the year. Also, as you observe the birds feeding don't overlook the use of your trustworthy binoculars. It is fascinating to watch the ingenuity of birds as they retrieve food from seeds and buds. You can see why trees that bear large, meaty seeds, like acorns and nuts, and those with fleshy or juicy fruits, like crab apples, attract birds. These foods fill a bird's belly fast, but smaller tree seeds and even tender buds are also relished by some birds (Roth 303).

Specific Trees Found on the Cesar Chavez Campus

Baldcypress (Taxodium distichum)

This pyramidal shaped specimen tree soars to heights of 60-80 feet with a 25-35 foot span. Bears a 1" oval shaped, dry fruit, which attracts many forms of wildlife. Leaf color is light green, changing to showy copper or yellow in the fall. Although the tree is native to wetlands its growth is often faster in moist, well drained soil. (Gilman 544)

Chinese elm (Ulmus parvifolia)

The Chinese elm, also known as Drake elm, features a rounded or weeping vase shape. Considered an excellent specimen for planting in "green zones" of parking lots, primarily because of its tolerance to urban heat, the Chinese elm can actually attain heights up to 40-50 feet, with a span of 35-50 feet. Leaf color ranges from dark green during warm seasons to fall colors of purple, red or yellow. The buds of the elm attract cardinals as well as many other species of birds.

Chinaberry (Melia azedarach)

Rapid growing rounded vase shaped tree which reaches a modest 30-40 feet height with 20-25 foot span. Although the fruit is quite small (0.3") and hard, it is very tasty to numerous birds, that are readily attracted to the fruit's golden yellow fall color.

Arizona ash (Fraxinus velutina)

Arizona ash grows to 40-50 feet with the same span. This round shaped tree is characterized by its elongated, .5-1" dry fruit. The fruit starts out green but transforms into tan as it ripens. The Arizona ash is often referred to as a "trash tree" because of the large amount of litter that falls from the tree as the fruits drop to the ground. This tree is considered a fast growing tree, however only a moderate life span.

Pecan (Carya illinoensis)

The state tree of Texas, this tree needs plenty of space as it easily soars to heights up to 100' and a spread of 50-70'. The pecan tree has a unique form, symmetrical, broadly oval crown and is massively branched especially if the main trunk is headed.(Gilman 190) The leaf color is medium green in summer to somewhat yellow in the fall. Leaves are alternate; odd pinnately compound; serrate margin; lanceolate, deciduous; 4-6" long leaflets. The 1-2" dry, hard, brown fruit is oval to round shaped and attracts squirrels and other mammals.

Live oak (Quercus virginiana)

A large, sprawling, picturesque tree, the live oak grows up to 80' with widths reaching 60-120'. Live oaks are moderately rapid growing trees that are long lived. The growth habit of the live oak can be described as spreading and rounded; dense; nearly symmetrical; fine textured. Leaves are dark green; evergreen to semi-evergreen.

Chinese tallow (Sapium sebiferum)

The Chinese tallow is an invasive tree that has actually been banned in some states, including Florida. This tree grows to modest heights of about 35'. Chinese tallow is fast growing but short lived. The plant readily grows in wetland areas and uncontrolled can take over in a short time. This is precisely what happened along the bayou that was selected as the site for our outdoor learning center. Numerous Chinese tallow and Chinese privet were removed to make room for our center.

Common hackberry (Celtis occidentalis)

Hackberry grows naturally in moist bottomland soil and mesic sites, but will grow rapidly in a variety of soil types. Leaves are alternate, simple, serrated margins, oval to ovate, deciduous, and 2-4" long. Hackberry can reach heights up to 80' with span of 40-60'. The fruit of the hackberry is round, less than .5", fleshy, purple, red, and attracts many different species of wildlife.

Other Noteworthy Woody Plants

The table below contains information about some of the other woody plants (trees, shrubs, vines) that you might have in your outdoor learning center or could consider adding at some time in the future. This information was taken from works by Sally Roth.

PLANT VARIETY	NOTES
Flowering dogwood *Cormus florida*	Large shrub or small tree with fruit favored by 36 species of birds
Crab apple *Malus sp.*	Small ornamental tree that produces bird pleasing fruits.
White oak *Quercus alba*	Grand shade tree that produces acorns enjoyed by blue jays, thrashers, and flickers. Also good nest site.
Elderberry *Sambucus Canadensis*	Decorative small tree. Over 30 species of birds eat the fruit of this tree.
Blackberries	Left unattended to tangle in a thorny mass, berry vines serve as nesting sites and escape areas. Berries are popular foods among birds.
Hawtorn *Crataegus sp.*	Small domed tree with clustered flowers and red fruits. Choice site for nesting.
Viburnum *Viburnum sp.*	Attracts blue jays, robins, bluebirds, wax wings, and many other song birds.
Honeysuckle *Lonicera sp.*	Select a tall variety, plant along a fence.

IDENTIFICATION AND CLASSIFICATION OF RANGE PLANTS

In the fall of 2003, students planted seeds of approximately fifty different native grasses and wildflowers. As these plants emerged students used the *Texas Range Plants* reference to identify the cool season plants that were planted. They followed this task in late spring to also identify warm season plants. Seeds that were known to be in the planting mix included sunflowers, bluestems, ryegrasses, salvia, primrose, Indian grass, purple top, to name a few. Students will classify plants based on information provided in *Texas Range Plants.* A lesson to accomplish this task has been provided. It is essential to know what species of grasses are growing in the prairie section throughout the year. Both warm season and cool season plantings must be included in order to attract wildlife the entire year. Knowing the preferred grasses of specific species will determine what you plant. You also want to make sure there is a good balance of plants so not to attract only one or a few different species of wildlife. In order to conduct meaningful and accurate studies in the prairie area you will need to make sure that no one mows the area without your permission. It will probably be necessary to post signs to prevent unscheduled mowing.

It is important to identify range plants and classify them as good, fair, and poor for the purpose of grazing for both livestock and wildlife. While it is very unlikely that you will have any actual grazing on your campus, it is important for the students to know how to determine the quality of the rangeland because of the economic value of the range. One day students might be able to apply this knowledge if they engage in ranching or need to determine the condition of a particular area being used for recreational purposes such as hunting. When your students begin the task of classifying plants consider the following specific categories:

Plant Parts

Each plant species has some part or parts that differ from other plants. These differences may be clearly visible to the eye but in some instances require closer scrutiny. This lesson will primarily focus on grass plants.

A grass plant is made up of roots, stems, culms, nodes, internodes, leaves, sheaths, leaf blades, and inflorescences. All parts may or may not be present, depending on the grass' stage of growth.

The stem is comprised of nodes and internodes and usually hollow. The primary function of the stem is to transport water and nutrients from the roots to the leaves and transport foodstuffs manufactured by the leaves to the roots for storage.

Located at each node are five buds. One bud may produce a stem, and the other four may produce roots. These buds remain dormant until they are needed by the plant. The leaf originates from the node. The leaf is made up of the sheath and the leaf blade, which are joined at the collar.

The collar is formed by the ligules and the auricles. Ligules are small leaf-like projections located next to the stem on the inside of the collar. Auricles are ear-shaped tips that clasp the stem found on the inside of the collar on some grasses. The growing point of the leaf is not where students might think. The tip of the leaf is actually the oldest part of the leaf. Leaves grow from the base.

The arrangement of the reproductive parts of a range plant is called the inflorescence. There are three basic types of inflorescences: spike, raceme, and panicle. The inflorescence is made up of many smaller units called spikelets. There are two leaf-like bracts known as glumes located at the base of each spikelet. The floret is a single grass flower. Each floret is supported on a short stem called a rachilla when there is more than one floret on each spikelet. Each fertile floret produces a seed at maturity called the caryopsis. The seed is enclosed by two other leaf-like bracts called the lemma and the palea.

There are several types of roots that also can be useful in the identification of plants. Stolons grow above the ground and are used by plants for reproduction. Bermuda grass is a classic example of grasses that spread growth by stolons. Rhizomes on the other hand, grow underground, and are also responsible for reproduction. The tap root is the root that grows downward with smaller roots branching from it. Forbs, shrubs, and trees typically have taproots. Fibrous roots are a network of small roots that are each approximately the same size.

The flower structures of grasses are different from trees and forbs. The sepals which form the calyx occupy the outermost position of the flower. The sepals usually are green in color. They sometimes mix with the petals. As you move inward you will locate the petals, which generally are larger than the sepals and often brightly colored. The petals collectively form the corolla. The corolla and the calyx make up the perianth.

IMPORTANT RANGE PLANT GROUPS

Range plants are also grouped into special categories concerning succession and climax. These groups include decreasers, increasers, and invaders. It is important to understand the characteristics of each of these groups to be able to evaluate a range site.

Decreasers

Decreasers are plants which decrease in abundance with grazing pressure. This group of plants is the most desirable of range plants for livestock. Decreasers change with each range site. The primary reason for this is due to different types of soils which determine the species of plants that will grow best. Decreasers are abundant when the range is in excellent condition.

Increasers

Increasers are less palatable than decreasers and therefore are not generally eaten by wildlife or lifestock as long as other more favorable choices exist. This allows these plants to escape grazing and replace the decreasers as grazing pressure increases. Increasers increase in abundance and decreasers decrease as the range condition drops to good or below. When the range condition is poor, increasers are common along with abundant invaders.

Invaders

Invaders usually are the least desirable of the plants found in the range site. Invaders usually come from other areas through migration and invade disturbed or overgrazed land.

Range Condition Classes

It should be noted that in each of the four range conditions (excellent, good, fair, and poor), that all three types of range plants can be found. The difference between range conditions is the amount of decreasers, increasers, and invaders found growing on a particular range site and making up the plant species composition. Range conditions are calculated by determining the amount of decreasers, increasers, and invaders that are on the site and then comparing them to a Soil Conservation Service range site guide. This guide will identify which climax species are adapted for that site and the percentage of the climax vegetation that they should comprise. This information allows one to calculate range conditions based on the acceptable amount of decreasers, increasers, and invaders found.

A range in excellent condition contains 76 to 100 percent of the climax species for that range site. One in good condition has 51 to 75 percent of the climax species remaining. A fair condition range has 26 to 50 percent climax. A range in poor condition contains 25 percent or less of the climax species.

You can physically alter different areas of your range site to create these different range conditions. This will be especially helpful for my students as we train teams to compete in the annual range and pasture judging events sponsored by the FFA. Use the table below to assist you in identifying specific information about the plants used in the State FFA Range Plant Identification Contest.

Range Plant Inventory

Once you know the identity of the different plants you have in your range site it is essential to calculate the percentages of these specific plants (primarily grasses and wildflowers). To accomplish this task you will need to conduct a census of those plants. The following procedure describes how to conduct a plant specimen inventory, which will also aid in determining the condition of your site. A lesson plan on conducting an inventory has been included.

To determine the approximate species population in a given area you will want to start with a simple square yard. This sampling should be random, and several counts should be taken if feasible. To make the counting process easier to visualize the first thing you will need to do is make a 1m x1m frame out of pvc pipe. (Figure 3) You can purchase the materials from your local home improvement store. You will need 2 - 12' long pieces of pipe. Cut 4 sections of pipe to a length of 1m each. I find that 1/2" works best. You might be able to ask someone at the plumbing department to cut it for you. You will also need 4 (45 degree) elbow joints. Connect the four sections of pvc together using the elbows to create a 1m x 1m frame, or 1 square meter. If you want to make the frame permanent you can also purchase pipe cleaner and pvc glue. Follow the instructions on the product label and be sure to put the frame together in a well ventilated area. I would

not allow the students to put this together, especially the younger ones. The advantage of not gluing the frame together is that when you are not using it, you can take it apart and store it more easily.

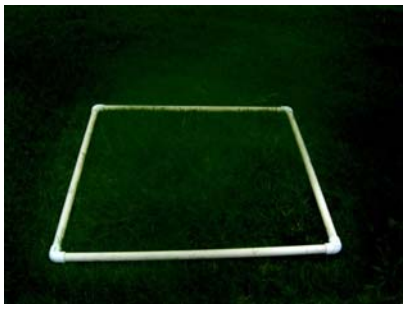

Figure 3- 1sq. Meter Frame
Made From ½" PVC

Once you put your frame together, make sure it is secure and square. Move to the area of your learning center that you wish to conduct your first census. It works best if you give the frame a little toss into the space you are working in and let it drop where it may. This gives you a true random sampling. However, if the frame is not glued together or at least solid, it may break apart on you. After you have selected your site, gently move any plants that are touching the frame to place them either inside of the frame or just outside of the frame, whichever causes the least amount of damage to the plants.

Utilization Techniques

It should be remembered that one of the main purposes of including a "range study" site is to provide students the opportunity to practice techniques used by ranchers or other landowners to manage their rangelands. Ranchers are actually indirectly selling forage plants to consumers, given the fact that these plants are the primary food source for the livestock and wildlife that are harvested from their range. The production of forage is measured quantitatively and qualitatively by weight, volume, frequency, area, diversity, vigor, and quality.

Weight

Biomass is generally accepted as the best method of determining (measuring) plant growth. Weight is usually expressed as dry weight per acre. The amount of water in plants varies both seasonally and annually. Therefore, clippings should be dried before making any comparisons to determine relative productivity.

Volume

Plant basal area (measurement of the plant's circumference at ground level) and height are two measurements used to determine plant volume. Combined with weight, life form

and species composition, volume can be an excellent way to characterize the habitat factors for livestock and wildlife. Habitat characters refers to any of the plants providing food and/or cover for animals and insects. (IMS Curriculum Material)

Frequency

The number of sample areas in which a plant species is present is the plant's frequency, which is expressed as a percentage rating. As you complete your plant inventory also note the frequency of the different species of plants you identify. Frequency is important because it helps determine the overall productivity of a rangeland. The Texas A&M Instructional Material Service Curriculum for Range Management & Ecology provides the following example:

A rangeland has two grass species, each producing 10% of the total dry weight production of the range. A range inventory shows species #1 with a frequency of 90% and species #2 with a frequency of 10%. This information should alert the range manager that only specific areas of the pasture produce species #2. Thus, the manager can better determine the habitat management of the soil, plants, and animals.

Area

Area refers to the amount of space occupied by some type of forage cover. The area covered by forage is a valuable tool in determining any one plant's dominance on a range site. Basal area is used for grasses. Canopy (the ground area covered by branches) is used for shrubs and trees. Visual estimates play a vital role in determining area covered by an identifiable species. To help students better understand this concept consider the following scenario. Two pastures have different occurrence frequencies of live oak (*Quercus virginiana*). One might draw the conclusion that there is more oak influence on pasture #1 with the higher frequency. In reality, the area is much greater in pasture #2 with less frequency of oak. Why? Pasture #2 contains fewer large oaks (thus the low frequency) which exert greater influence on the environment than does pasture #1, with more oak saplings (thus the higher frequency).

Diversity

The richness (# of species present in a plant community's population) and evenness (the distribution of abundance among species in a plant community's population), of the plant species present on a range site determines the species diversity. Species richness as a measure on its own takes no account of the number of individuals of each species present. It gives as much weight to those species which have very few individuals as to those which have many individuals. Thus, one bluestem has as much influence on the richness of an area as 1000 hairy gramma plants. It should be further noted that a community that is dominated by one or two species is considered to be less diverse than one in which several different species have a similar abundance. As species richness and evenness

increase, so diversity increases. There is a formula known as Simpson's Diversity Index that can be used to measure and quantify diversity.

Vigor

Vigor is the general appearance of a plant, and describes the health and productivity of the plant. When plants are over grazed or over browsed, they usually lose vigor long before changes in frequency, area and diversity can be measured. Changes in weather, precipitation, and soil fertility have a direct impact and can reduce or enhance plant vigor.

Quality

The nutritive value, edibility, and digestibility of the available forage determine its vegetative quality. Plant quality also changes seasonally and annually due to natural lifecycles and environmental factors. For example, young grass in the spring is higher quality than mature grass in the summer.

UTILIZATION MEASUREMENT TECHNIQUES

To really understand the importance of determining quality of range plants and see how the range site would measure up to real life applications you may wish to consider completing one or both of the following activities.

Clipping to Determine Herbage Production

The most accurate way to determine flora production on a range site is to clip, dry, and weigh plants from a group of small plots (each plot usually one square meter in area). Numerous plant plots are clipped. Samples are placed in a bag and taken back to the lab to be dried and weighed. Weights of each plot are then multiplied by an adjustment factor to obtain the desired measurement (kilograms/hectare or pounds/acre). The sample weight values are averaged to gain an estimate of herbage production for the entire site. The number of plots to be clipped to serve as a good estimate depends on: (a) the size of the clipping plots, (b) the size of the area to be estimated, and (c) the continuity or lack of continuity of the vegetation of the area to be estimated.

Clipping to Determine Herbage Utilization

Determining accurate herbage utilization can be difficult. In an open pasture, or range, you will have to select sites that must be enclosed to prevent livestock and wildlife from grazing inside your test plots. The production inside the enclosures is compared to the production of surrounding vegetation. Samples from the enclosure and outside surroundings are clipped, dried, and weighed. Average difference among the plots is determined. The difference is the herbage utilization by the herbivores on the particular site.

SPECIAL HOUSING FOR WOOD DUCKS

In our outdoor learning center we try to rely strictly on the homes that nature has already provided. For example, we know that one hollow tree at the edge of our wetlands is home to a family of raccoons. Numerous birds, including robins, cardinals and hawks are found throughout the wooded area of the center. We have also witnessed herons and different species of ducks fly in and out of the wetlands (among those, wood ducks). We have decided to construct a nesting box for the wood ducks that have been attracted to our learning center. Special care will be taken in the design and location of the nest box so that it blends into the area. In other words, we don't want our human visitors to be aware of its existence. However, we must make certain the box is placed in an area the wood ducks already visit. The box will have to be made "predator proof" to protect the eggs in the nest. A lesson plan on how to construct a wood duck box is included.

Materials used to construct the nest box should be weather-resistant. Cedar or cypress is often recommended. If you decide to paint or stain the box, be sure that only the outside surface is treated. The entrance hole should be an oval that is 3 inches high and 4 inches wide. This shape will allow easy access for the wood duck hen, but will discourage entry by raccoons and squirrels. Place a 3-inch wide strip of ¼-inch mesh hardware cloth inside the box under the entrance to function as a ladder for the hen and newly hatched ducklings. Place a 3-inch layer of coarse sawdust in the bottom of the box to serve as nesting material. The lid or one side of the box should be removable to facilitate monitoring and cleaning. Secure the predator guard 6 to 12 inches below the bottom of the box.

Wood ducks are highly secretive in selecting nest sites to minimize impacts of nest predators and competition from other wood ducks. Locate the nest box in a relatively secluded area. The box can be placed either over land or water. If you decide to place the box over water, place it at least 4 feet above the high water level and the entrance hole should face the open water rather than the shoreline. Since the amount of natural water in the learning center may be limited, this may not be possible.

Maintenance and a monitoring plan should be well thought out long before the nest box is installed. Boxes also make ideal homes for other birds such as European starlings, and must be cleaned out regularly if the box is to be used more than once during a nesting season. Monitoring should be done once before nesting season starts and once monthly during the season. Another important reason for monitoring the nest box is "egg dumping." The normal brood size for wood ducks is 10 – 15. If there are considerably more eggs in the box it is likely that "egg dumping" has occurred. This practice, also known as intraspecific brood parasitism, occurs for several reasons. Nest predation and the lack of nest sites are the most prominent. Frequently a first year breeder follows another hen to hidden or scarce nest sites during the egg-laying period. The visiting bird deposits her eggs in the nest of this other hen. A hen whose nest is dumped with too many eggs may abandon the nest altogether. In a natural setting, approximately 80

percent of the eggs hatch. However, if egg dumping is out of control the rate could drop to as low as 10 percent.

TEACHING STRATEGIES

The main goal of this curriculum unit is to provide students with information that can be used to create an outdoor learning center that, once completed, will not only attract wildlife, but will hold wildlife for long term studies. Students learn in many different ways, and many different strategies will be used to meet those needs.

Students will conduct various experiments, which in many cases will span the entire school year to complete. Since ongoing monitoring is essential to determine affects of pollution and other environmental impacts on the air and water available to the wildlife we hope to attract to our outdoor learning area, these tasks must be repeated often. Students will also use various graphic organizers to process the information they will learn during their studies and will be evaluated on their degree of participation, team effort, and individual effort. They will be assigned a culminating project to highlight what they found to be most memorable from their experiences with the wild creatures observed. Students will be encouraged to extend their learning through enrichment projects for extra credit.

LESSON PLANS

The following lesson plans should provide students with practical, “hands-on” learning opportunities. It should be noted that there are many ways for students to experience the wildlife found in their own backyard. Although very few schools will have the opportunity to create native prairies in the school outdoor learning lab, the lesson plans that I have provided here can be applied to any area of the school yard that is covered with vegetation. Teachers and students should always follow good safe practices whenever working with hand tools and/or chemicals.

Lesson I: Range Plant Classification

Range plants can be classified by their physical structures, season of growth, life cycle, and climax classification. Range plants should fit into one of the following six categories:

Grasses	Shrubs and Trees
Forbs	Grass-like Plants
Legumes	Succulents

In this activity students are to collect specimen plants from various locations around the school or home. Be sure to attain permission before collecting plants. Also be sure that you dig the plants from the ground in order to secure as many of the roots as possible. Plants will be brought into the classroom or lab for investigation.

Materials Needed
Field Guide on Native Grasses
Old Newspapers
Digging Tool
Student Journal
Pencil
Magnifying Glass
Student Work Sheet

Objective
The Learner Will Be Able To (TLWBAT):
Identify range plant specimens and classify them into one of the six known categories.

Procedure
1. Inspect the school grounds or back yard for plant specimens.
2. Carefully remove the plant from the ground. Do not pull the plant out of the ground as this will cause damage to the plant.
3. Carefully place the plant inside of a piece of folded newspaper. Make note in your journal where the plant was taken from, date and time of collection.
4. Continue collecting plants until you have 5 different specimens.
5. In the lab you will visually inspect each plant with a magnifying glass to get a better idea about the plant's characteristics. Visually inspect and note your observations about the plant's roots, stem, florescence, leaf type, leaf arrangement, seeds, color or any other unique qualities about the plant.
6. Compare your observations with illustrations in the field study guide.
7. Make a sketch of the plant, labeling each part and writing notations about your findings (example: hairy nodes). Use the checklist found in the appendix or create your own.
8. Based on your findings determine which class to categorize each plant.

Lesson II: How to Conduct a Plant Specimen Inventory

You will need to use a field guide to assist you in the identification of the different species of plants that are growing in your range study site. Remember the main reason you want to conduct this inventory is to determine what species of plants are available for use by the wildlife that will be visiting your outdoor learning center.

Materials Needed
Field Guide on Native Grasses
Student Journals
Field Study Worksheet (located in appendix)
Pencil
Graph Paper

Calculator
3'x3' PVC Frame

Objectives

The Learner Will Be Able To (TLWBAT):

1. Determine the percentage of a "test plot" that is covered by vegetation.
2. Identify the different plants growing in the "test plot" by species and determine classification as decreaser, increaser, or invader.
3. Determine the percentage of each species of plants growing in the "test plot".
4. Determine the condition of the range based on the percentage of decreasers, increasers, and invaders present in the "test plot".

Procedures

1. Randomly select an area to serve as your "test plot" by gently tossing your PVC frame onto the ground, following safe practices.
2. Gently rearrange plants that are touching the frame either inside or outside of the frame by following the plant stem to its base, or whichever placement causes the least amount of damage to the plant.
3. Make a quick overview of the "test plot" to estimate the percentage of the area inside the frame which is covered by some form of vegetation. Record this estimate on the field study worksheet.
4. Use the field study guide to assist you in the identification of the plants that are growing inside of the frame. Count the number of each species and list these on your field study worksheet in the space provided. Identify plants as decreaser, increaser, or invader.
5. Use graph paper to indicate the location of the different plant species that are growing in the "test plot". Use any symbol or letter you want for each species, just be consistent.
6. Use the calculator to complete the exercises on the field study worksheet.

Example

The drawing below illustrates what your test plot might look like. In this example the following symbols are used to represent different species of grasses found inside the frame: B-Big bluestem, L-Little bluestem, C-Curley mesquite, S-Sunflower, empty squares indicate bare spaces in the test plot. For the sake of simplicity in this example only on plant is present inside of each grid. In a true setting there will likely be more.

B	B	C	C	C	C	C	B	C	C
C	C	C	C	C	C	C	C	C	C
L	L	L	C	C	C	C	C	C	C
L	C			C	C	C	C		
L	L	L	C	C	C		C	C	C
B	B	B				S		C	C
L	L	L		L	L	L	C	C	C
C	C	C	C	C	C	C	C	C	C
C	C	C	C	C	C	C	C	C	C
C	C	C	C	C	C	C	C	C	C

Graph Paper to Identify Findings

Field Study Findings

1. There are 10 spaces of the 100 total spaces on the graph paper that are open. This would be equal to 10% (10/100=.10x100=10%). The remaining 90% is therefore covered by some form of vegetation.
2. Big bluestem(B) occupies 6 spaces. This would equal 6% (6/10=.6x100=6%). Big bluestem is an increaser.
3. Little bluestem(L) occupies 13 spaces or 13% (13/100=.13x100=13%). Little bluestem is also an increaser.
4. Curly mesquite(C) occupies 60 spaces or 60% (60/100=.6x100=60%). Curley mesquite is a decreaser. Curley mesquite is also our climax species.
5. Sunflower(S) occupies a single space which would be 1%(1/100=.01x100=1%). Sunflower is definitely out of place here and therefore would be an invader. However, please note that although the sunflower would have no value to livestock or deer, other forms of wildlife would benefit greatly from its presence.
6. Based on the data collected here we can identify the climax species as Curley mesquite, which occupies 60% of our area. Based on the Soil Conservation Service guidelines, climax species that occupy 51-75% of the range site fall into the "good" condition category. Therefore, our range site is good.

To determine the actual % of each species use the following formula.

$$\frac{\#\,of\ Specific\ Species}{Total\ \#\,of\ Plants\ in\ Test\ Plot} \times 100 = \%\ of\ Specific\ Species\ in\ Test\ Plot$$

*****Note: Repeat this activity at several other random locations and compare your findings to obtain an overall rating of the range site. Also try completing inventory activities during different seasons of the year and compare those findings with this initial report. Is one season more populated than others? Explain.

Lesson III: How to Construct and/or Install a Wood Duck Nest Box

If your students are handy with tools you can easily construct the wood duck nest box illustrated below. It cannot be overstated that you must install the predator guard to protect the nest from squirrels, raccoons and snakes.

Objectives
The Learner Will Be Able To (TLWBAT):
Provide a nest box for wood ducks.

Procedures
1. Figure 4 illustrates a typical wood duck nesting box design. When installing the guard, overlap the cut edge to the dotted line. To facilitate cutting, follow the sequence of numbers. Make circular cuts in counterclockwise direction. To make initial cut on line A-B, make a slot at A with a wood chisel.
2. Once you have completed the construction of the nest box you are ready to hang the box in the predetermined location. The greatest difficulty you will encounter will probably be crafting the predator guard. (Figure 5) You may need to seek the assistance of a metal fabrication technology teacher if you have one at your school.

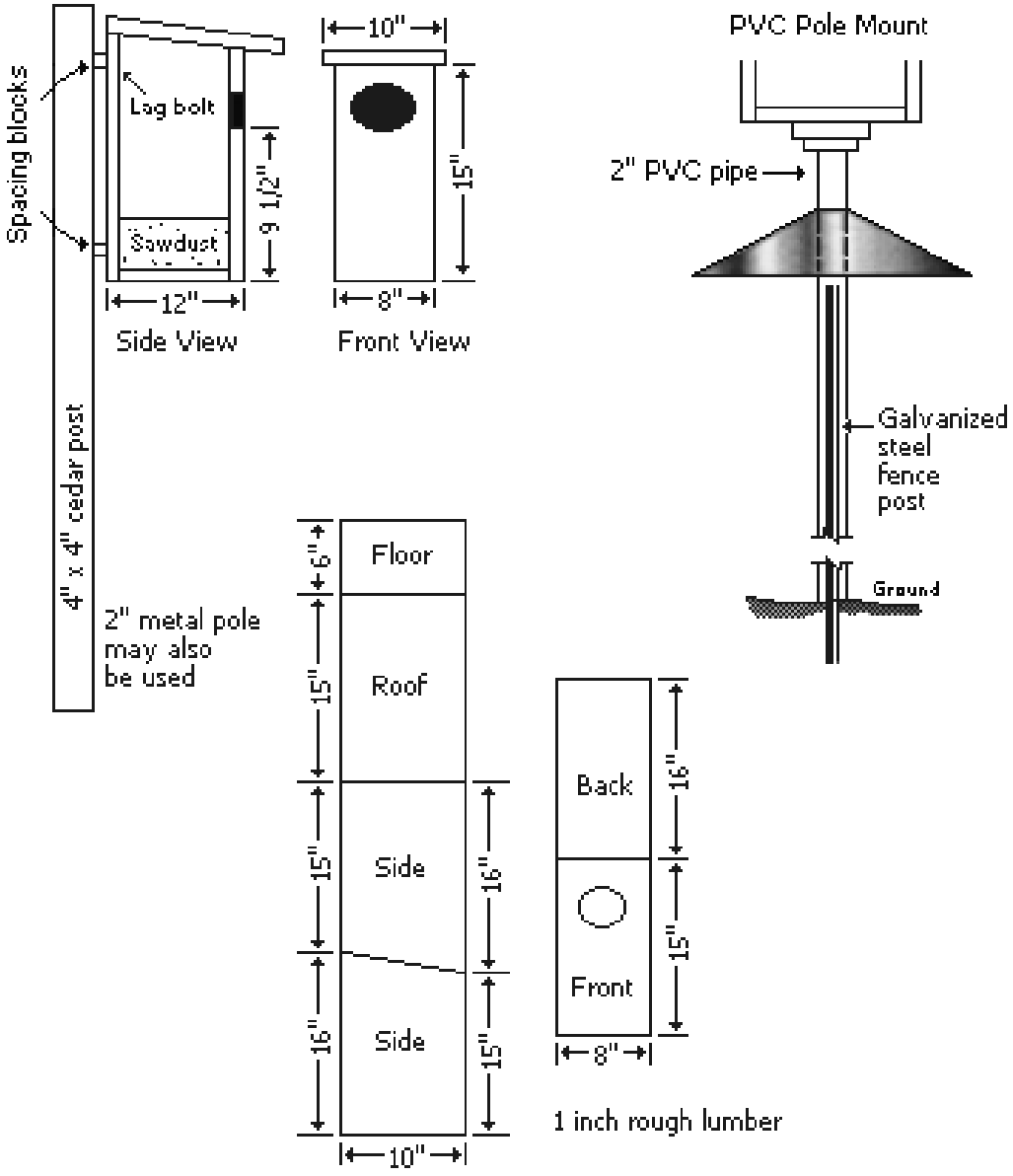

Figure 4- Typical Plans for a Wood Duck Nesting Box

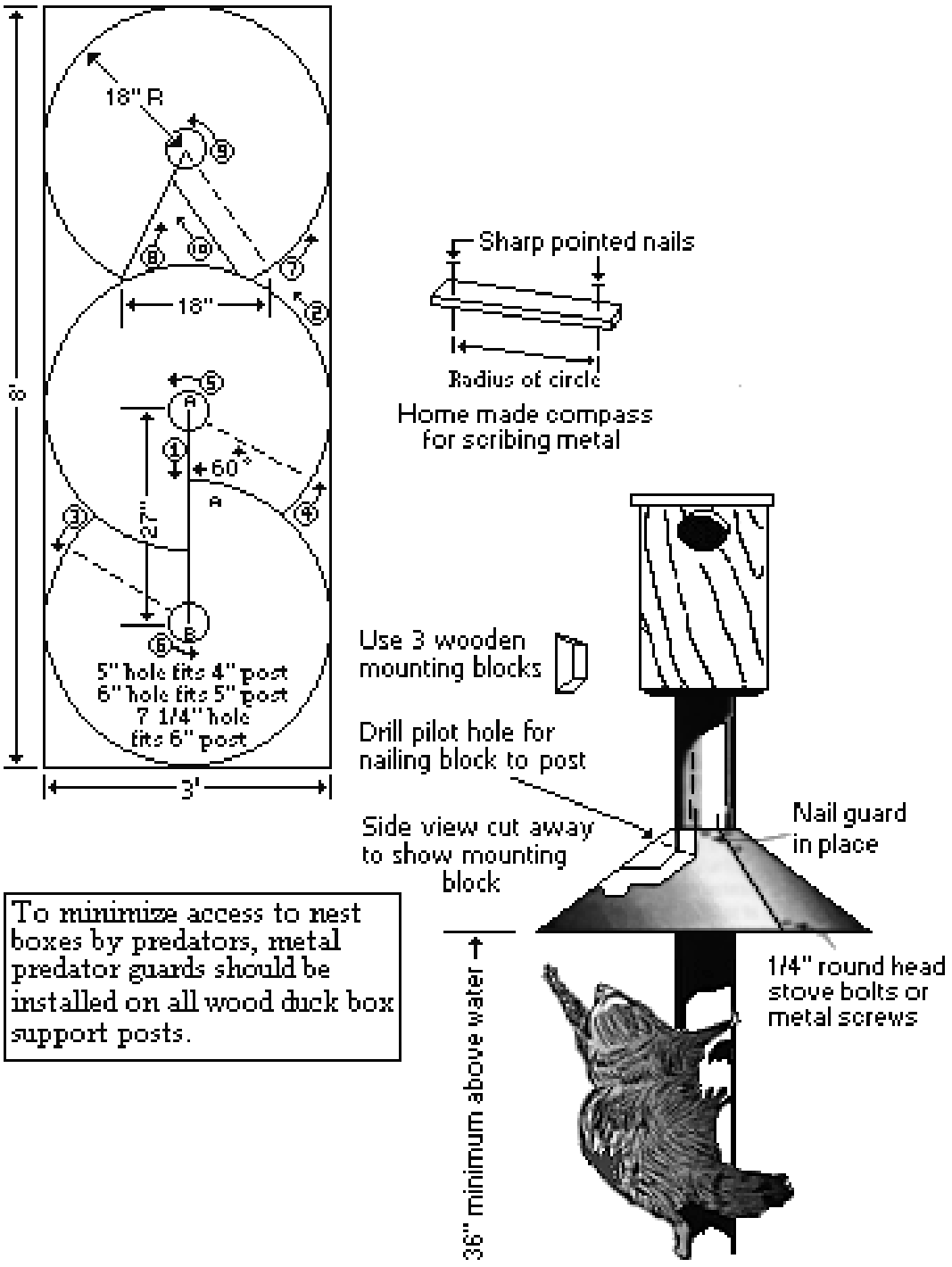

Figure 5 – Plans for Predator Guard

APPENDIX A

PLANT CLASSIFICATION WORKSHEET

Reproduce this worksheet and use for each specimen plant you are trying to classify.

Name _____ Date _____

Location of Specimen _____ Date Collected _____

Examine the specimen closely and compare with illustrations found in your field guide. Indicate each characteristic (if present) by placing an "x" in the appropriate space.

	CHECK APPROPRIATE BOX FOR EACH CHARCTERISTIC				
PLANT CHARACTERISTIC	spike	spicate raceme	raceme	open panicle	
Inflorescence Type					
	absent	ring of hairs	membranous	ciliate membrane	
Ligules of Grass Leaves (Type)					
	acuminate	obtuse	acute	truncate	
Ligules of Grass Leaves (Shape)					
	entire	notched	erose		
Ligules of Grass Leaves (Margin)					

	sessile	petolate	clasping
Leaf Attachment			

	procumbent	erect	ascending	creeping	decumbent
Plant Growth Habit					

	opposite	alternate	whorled
Leaf Arrangement			

	caulescent	acaulescent
Types of Forb		

	stolon	rhizome
Horizontal Stems		

	simple (pinnate venation)	simple (parallel venation)	pinnately compound (3-foliate)	palmately compound (3-foliate)	simple (scale-like)	palmately compound (9-foliate	simple (needles)	pinnately compound (even)	pinnately compound (odd)	bipinnately compound
Leaf Types										

	deltoid	elliptic	linear	lanceolate	oblanceolate	oblong	orbiculate	obovate	ovate	sagittate	spatulate	filiform
Leaf Shapes												

	acuminate	acute	cleft	emarginate	obcordate	obtuse	apiculate	rounded	truncate
Leaf apices									

	ciliate	cleft	crenate	dentate	dissected	double serrate	entire	erose	incised	lobed	pinnatifid	serrate	sinuate	undulate
Leaf Margins														

APPENDIX B

FIELD STUDY WORKSHEET
RANGE STUDY SITE

Name _____ Date _____

Study Plot # _____

1. Estimate the % of area covered with vegetation _____

2. Plant Species Inventory – List the names of each of the different plant species found in the test plot and assign each one with a symbol. This symbol will be used to complete part 3 of the work sheet. Use the master plant list provided in the appendix to complete the information requested in the table below.

Plant Species Identified/Symbol	Longevity		Growing Season		Origin		Economic Value For Wildlife		
	Annual	Perennial	Cool Season	Warm Season	Native	Introduced	Good	Fair	Poor

3. Use the symbols you selected to indicate the location of each of the plant species found in the test plot by placing the symbol in the appropriate grid. Leave grids blank to represent bare spaces within the test plot. Once you complete the grid you can determine the percentages of the different species growing in the test plot.

4. Visual Estimates – Study the completed chart to answer the following questions. There are 100 individual grids in the chart above. To estimate the percentages of each specimen simply count the number of grids that contain the symbol for that specimen. Each grid is equal to 1%.

a. What % of the test plot is covered with some form of vegetation? _____
b. What % of the test plot is covered by specific species?

1. _____ _____%
2. _____ _____%
3. _____ _____%
4. _____ _____%
5. _____ _____%
6. _____ _____%
7. _____ _____%
8. _____ _____%
9. _____ _____%
10. _____ _____%

5. Actual Plant Count – As you identify the plants within the boundaries of your frame take an accurate count and enter the information in the table below.

Plant Species	Symbol	# of Plants	% of Total Plants
Total # of Plants in Test Plot			

To determine the actual % of each species use the following formula. Enter the findings in the far right column of the above table.

$$\frac{\#\,of\ Specific\ Species}{Total\ \#\,of\ Plants\ in\ Test\ Plot} \times 100 = \%\ of\ Specific\ Species\ in\ Test\ Plot$$

ANNOTATED BIBLIOGRAPHY

Works Cited

Curriculum Materials for Agriscience 382, Range Management & Ecology. Texas A&M University: Instructional Materials Service Center.
Student materials developed for Range Management & Ecology by the staff at the Texas A&M University Instructional Materials Service Department of the Department of Agricultural Education

Gilman, Edward F. *Trees for Urban and Suburban Landscapes.* Delmar Publishers, 1997.
This technical book will be used to provide information about specific trees that are located on the school campus and surrounding area.

Hatch, Stephan and Jennifer Pluhar. *Texas Range Plants.* Texas A&M UP, 1993.
This resource manual has excellent illustrations and easy to follow information about the many different types of range plants, not only grasses, found across the State of Texas.

Supplemental Resources

Books for Teachers and Students

Better Homes and Gardens Complete Guide to Gardening. Meridith Corporation, 1979.
This colorful reference has a great deal of information on how to landscape the yard to attract birds and other forms of wildlife. I found the numerous charts and graphs to be particularly helpful.

Bridwell, Ferrel M. *Landscape Plants – Their Identification, Culture and Use.* 2nd Ed. Delmar Publishers, 2003.
This reference will be used to identify other species of trees and shrubs that are suitable for urban plantings. Chapter 3 provides pertinent information on the functional and aesthetic uses of plants.

Burton, L. DeVere. *Ecology of Fish and Wildlife.* Del Mar Publishers, 1996.
This excellent text provides numerous illustrations about the different species of wildlife of North America. The text is easy to follow and a glossary of terms is provided.

Cain, S.A. "Sample Plot Techniques Applied to Alpine Vegetation in Wyoming." *The American Journal of Botany* 30: 240-247.

Camp, William G, et al. *Managing Our Natural Resources,* 4th Ed. Delmar Publishers, 2002.

This textbook presents a balanced viewpoint of the place of humans in the world as long-term residents. Information from chapter 35 focuses on advanced concepts in natural resource management.

Deal, Kevin. *Wildlife and Natural Resource Management.* 2nd Ed. Delmar Publishers, 2003.
This textbook presents an excellent history of wildlife management in America. Chapter 11 is devoted to wildlife parks and zoos, from early zoos in the United States to modern zoos and wildlife parks.

Invite Birds to Your Home. United States Department of Agriculture: Soil Conservation Service, 1990.
This pamphlet developed by the USDA, Soil Conservation Service, provides information on providing plantings that attract birds into the backyard.

Kreigel, John. *Houston Home and Garden - Houston Garden Book.* Shearer Publishing, 1983.
This wonderful reference leaves little doubt about the plants that are best suited for the Houston area. A great resource if you are planning to landscape a corner of your school campus or your back yard. Several photographs of Houston landscapes stimulate the mind as to what could be.

Roth, Sally. *Attracting Birds to Your Backyard.* Rodale Organic Living Books, 1998.
This is an easy to read reference which offers colorful illustrations that even the youngest readers should be able to find helpful.

_____. *The Backyard Bird Feeder's Bible.* Rodale Organic Living Books, 2000.
According to one testimonial on the back cover of this reference, this book "goes far beyond the traditional books on backyard bird feeding . . . ." Color photography replaces the illustrations of the previous named reference.

Web Sites

Creek Connections. 2004. Allegheny College <http://creekconnections.allegheny.edu>.
This site provides information about the Creek Connections program that has swept the upper East Coast. This program is a partnership between Allegheny College and K-12 schools in that region. Students are involved in projects along different waterways to create outdoor learning labs. Visit this site to get ideas on projects you might want to try along the waterways near your school.

Simpson's Diversity Index. 2002. Offwell Woodland and Wildlife Trust.
<http://www.offwell.free-online.co.uk/simpsons.htm>.
This website explains in full detail Simpson's formula for determining diversity using Simpson's Diversity Index.

Texas Commission on Environmental Quality (formerly Texas Natural Resource Conservation Commission). 2004. <http://www.tceq.state.tx.us>.
Use this site to find data on air and water quality of your school or home. You can review historical data as well as view "real-time" data.

Texas Environmental Profiles. 2004. Environmental Defense and The Texas Center for Policy Studies. <http://www.texasep.org>.
This is another good site to check state-wide data on air and water quality.

Texas Parks and Wildlife Department. 2004. <http://www.tpwd.com>.
Students can explore hunting and fishing opportunities in the State of Texas. Students can also follow links to learn specific information on various species of wildlife in the State.

Texas State Soil & Water Conservation Board. 2004. <http://www.tssswcb.state.tx.us>.
You can find information at this site on contests and other extension activities your students can get involved in. There are activities for all ages.

United States Department of Agriculture Forest Service. 2004. <http://www.fs.fed.us>.
This site will give you information on many areas of wildlife, but be sure to check out the "Just for Kids" link. It is really cool, and offers kids a chance to explore many other areas related to agriculture.

Von Gausig, Doug. *Nature Songs*. 2004. <http://www.naturesongs.com>.
If you want to hear what sounds different birds make, check out this site. Click on the North American Birds link to begin your journey through the remarkable sounds of the birds that we all love. Other nature sounds can also be explored here if you so chose.

Wood Duck. 2004. U.S. Dept. of the Interior, U.S. Geological Survey.
<http://www.npwrc.usgs.gov/resource/1999/woodduck/woodduck.htm>.
This excellent website offers general information about wood ducks and nesting houses for wood ducks. Be sure to check out the other links provided here.